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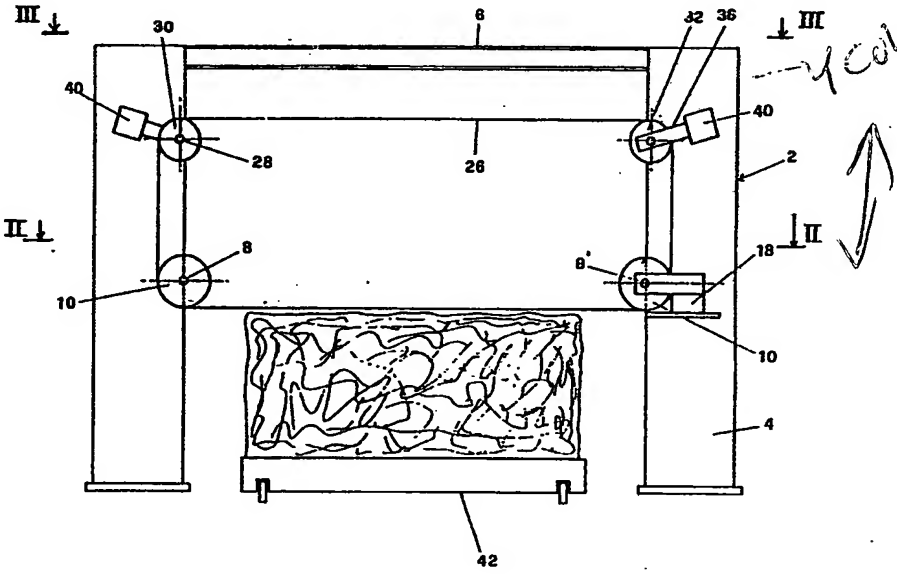

(57) Abstract

A machine for the multiple cutting of blocks of stone material, comprising a support and guide structure (2) for a multiple cutting tool movable relative to the block (12) of stone material to be cut, characterised in that said multiple tool comprises: a pair of horizontal support shafts (8, 8') for a plurality of guide pulleys (10) arranged such that with each pulley mounted on one shaft, at least one of said coplanar pulleys being motorized; a pair of deviation pulleys (30, 32) associated with each pair of guide pulleys (10) and arranged to form two series of side-by-side pulleys, in which one pulley (32) in two is associated with a tensioner (40); and a plurality of diamond-set wires (26) extending endlessly about two guide pulleys (10), a deviation pulley (32) associated with a tensioner (40) and a deviation pulley (30) not associated with a tensioner.

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Machine for the multiple cutting of blocks of stone materials.

Machines for cutting marble or granite blocks to obtain slabs of the desired thickness therefrom are well known. A known type of machine comprises a frame on which a number of parallel blades driven with reciprocating movement are mounted to cut the block of stone material into a number of slabs related to the number of blades simultaneously operated. In the case of a marble block the blades are provided with diamond-set cutters whereas in the case of a granite block the blades are not diamond-set and operate with abrasive paste fed between them and the block to be cut. In this latter case the cutting of the block is a very slow operating and does not satisfy current production requirements.

Machines are also known for cutting a block of stone material with diamond-set wires. These use one or more endless diamond-set wires supported by a frame and driven with continuous axial movement. This machine substantially increases the penetration rate, ie the speed with which the wire penetrates the block of stone material. However this greater operating rate results in lower cutting accuracy due essentially to the difficulty of tensioning the various wires

independently of each other, ie of maintaining all wires at the corrent tension independent of inevitable differences in their length and elongation. Again, independent tensioning would require an independent tensioner for each diamond-set wire, with an evident space requirement which would limit the minimum thickness obtainable for the slabs.

A further drawback of known diamond-set wire machines is that they are very inflexible in their performances in the sense that the thickness of the slabe to be cut cannot be varied without replacing the entire frame supporting the diamond-set wires.

These drawbacks are obviated according to the invention by a machine for the multiple cutting of blocks of stone material, comprising a support and guide structure for a multiple cutting tool movable relative to the block of stone material to be cut, characterised in that said structure comprises uprights along which there move support carriages for said multiple tool, which comprises:

- a pair of horizontal support shafts for a plurality of guide pulleys arranged such that with each pulley mounted on one shaft there corresponde a coplanar pulley mounted on the other shaft, at least one of said coplanar pulleys being motirized;

- a pair of deviation pulleys associated with each pair of guide pulleys and arranged to form two series of side-by-side pulleys, in which one pulley in two is associated with a tensioner; and
- a plurality of diamond-set wire extending endlessly about two guide pulleys, a deviation pulley associated with a tensioner and a deviation pulley not associated with a tensioner.

The present invention is further clarified hereinafter with reference to the accompanying drawings, in which:

Figure 1 is a schematic side view of a machine according to the invention for cutting a block of stone material into slabs;

Figure 2 is a plan view thereof on the line II-II of Figure 1;

Figure 3 is a plan view thereof on the line III-III of Figure 1;

Figure 4 is a enlarged axial section through the system for spacing apart the guide pulleys, taken on the line IV-IV of Figure 5;

Figure 5 is a longitudinal section therethrough taken on the line V-V of Figure 4';

Figure 6 is an enlarged side view of a deviation pulley

associated with a tensioner; and

Figure 7 is a longitudinal section therethrough on the line VII-VII of Figure 6.

As can be seen from the figures, the machine according to the invention comprises an essentially portal-shaped structure 2 with four uprights 4 resting lowerly on the ground and upperly connected together by a rectangular frame 6. The multiple cutting tool can slide vertically along the four uprights 4, it being shown on the drawings only in its significant parts, is without the members for its vertical movement, these consisting essentially of carriages which allow the tool to move vertically with a speed adjustable from a minimum value at the commencement of cutting, to a nominal cutting value which is maintained costant during working.

The multiple cutting tool comprises four parallel shafts 8,8',28 supported at their ends by said carriages, not shown.

With reference in particular to Figure 1, these shafts are perpendicular to the plane of the drawings and are arranged two lowerly in the same horizontal plane and two upperly in another horizontal plane distant from the first. The two lower shafts 8,8' purpose is to guide, as will be apparent hereinafter, the diamond-set wires 26 during their

descent into the marble or granite block 12 to be cut into slabs, and which is positioned within the structure 2.

One of the two shafts, namely the shaft 8 to the left on the drawing, is coupled by belts 14 to an electric motor 16, whereas the shaft 8′ is mounted idly on its supports, which are themselves mounted on carriages 18 for moving the shaft 8′ away from and towards the shaft 8.

Each of the pulleys 10 mounted on the shafts 8,8′ comprises three recesses 20 in both its surface and arranged radially at 120° apart. These are provided to house corresponding spacers 22 which together with the recesses 20 are provided with passage holes for threaded rods 24 to enable all the pulleys 10 mounted on one and the same shaft 8,8′ to be rigidly clamped together.

The lateral surface of each pulley 10 comprises a circumferential groove which houses and guides a diamond-set wire 26, ie an endless wire of steel, glass fibre, carbon fibre or the like, on which diamond-set beads composed of a diamond matrix ring on a steel or other support core are threaded. The outer diameter of the diamond-set beads is preferably about 6 mm, as this size enables cutting thicknesses with only 8 mm of scrap to be achieved.

The two upper shaft 28, which are positioned above the

shafts 8,8′ and are parallel to them, each supports a plurality of idle deviation pulleys 30. The pulleys 30 are mounted on said shafts 28 at a distance between centres substantially double the distance between centres of the guide pulleys 10 mounted on the respective shafts 8,8′, between two adjacent deviation pulleys there being mounted a tensioning pulley 32. This has a central hole of substantially greater diameter than the diameter of the shaft 28, this hole being surrounded by a sleeve 34 projecting from both sides beyond the surface of the pulley and engaged by the arms of a fork element 36. This fork element is connected via an articulated joint 38 to a tensioner 40 formed in such a manner as to exert a traction force on the relative pulley 32 but without causing this to change the plane in which it lies.

The arrangement of the pulleys 30 and 32 is such that with each deviation pulley 30 mounted on one shaft 28 there corresponds a tensioning pulley 32 interposed between two deviation pulleys mounted on the othere shaft.

The lateral surface of the pulleys 30 and 32 also comprises a circumferential groove for the diamond-set wires 26, but whereas the two guide pulleys 10 relative to each diamond-set wire lie in a vertical plane forming the cutting

plane, the deviation pulley 30 and tensioning pulley 32 relative to the same diamond-set wire lie in a vertical plane slightly displaced from the first in order, as will be apparent hereinafter, to enable each diamond-set wire during its advancement to be also subjected to axial rotation to continuously regenerate its working surface.

The operation of the machine according to the invention is as follows:

before commencing the work, the multiple cutting tool is raised along the uprights 4 so that the lower horizontal portion of the various diamond-set wires 26 is positioned higher than the top of the block 12 to be cut into slabs, so that this can be positioned, for example by a trolley 42, between the uprights 4 below said tool.

The electric motor 16 is then started to rotate the pulleys 10 rigid therewith and with these the relative diamond-set wires 26, which are made to advance at constant speed with constant perfect parallelism of their lower horizontal portions by virtue of the geometry of the system, and individually maintaining the correct tension because of the presence of the tensioners 38. In this respect, the central hole through each tensioning pulley 32 allows the pulley to freely move perpendicular to the axis of the

corresponding shaft 28, and the coupling between each tensioning pulley and the relative support 40 enables the corresponding diamond-set wire to be set to the correct tension independently of inevitable differences in length and extension between them.

Simultaneously with the movement of the diamond-set wires 26 the multiple tool is made to descend slowly onto the block 12 to be cut. At the commencement of cutting the descent speed is a minimum and increases progressively until the predetermined nominal cutting speed is reached, this being maintained constant during the entire working. In this manner the lower horizontal portion of the diamond-set wires penetrates increasingly deeper into the block 12, to form a plurality of perfectly parallel uniform cuts, this being aided by the axial rotation of the wires and the continuous regeneration of their diamond-set surface.

During the stage the block 12 is continuously sprayed with water, the purpose of which is to both cool and lubricate the cutting region. During operation, a plurality of feelers is permanent contact with the wires and a plurality of inductive proximity sensors act together with a suitable detection system to immediately indicate any breakage or abnormal operation of a wire, to enable the

machine to be halted and appropriate action be taken to restore correct operation conditions.

When the block 12 has been completely cut into slabs, the multiple tool is again raised and the trolley removed to leave space for another trolley for repeating the cycle on another granite block.

From the aforegoing it is apparent that the machine according to the invention is particularly advantageous, in that:

- it enables a block of stone material to be cut into multiple slabs while maintaining the wires very close together, and at the same time under high tension, by virtue of the alternating arrangement of deviation pulleys and tensioning pulleys;
- it enables each wire to be set to the correct tension independently of the other wires and hence independently of inevitable differences in their length and elongation;
- it enables high operating speeds to be attained, to hence achieve production rates not previously obtainable;
- it is of very simple construction and of secure and reliable operation;
- it enables the obtained slab thickness to be easily varied by simply replacing the spacers between the guide pulleys

with others of the appropriate thickness;

- it enables each tensioner to operate under the best possible conditions by virtue of the articulated joint which arranges the relative support fork in the direction of the resultant of the forces deriving from the diamond-set wire 26;
- it provides high cutting regularity because of the continuous regeneration of the diamond-set wire surface and the maintaining of their perfectly circular cross-section; and
- it enables the diamond-set wires to be easily replaced, by moving the two guide pulley support shafts closer together.

C L A I M S

1. A machine for the multiple cutting of blocks of stone material, comprising a support and guide structure (2) for a multiple cutting tool movable relative to the block (12) of stone material to be cut, characterised in that said multiple tool comprises:

- a pair of horizontal support shafts (8,8′) for a plurality of guide pulleys (10) arranged such that with each pulley mounted on one shafts, at least one of said coplanar pulleys being motorized;
- a pair of deviation pulleys (30,32) associated with each pair of guide pulleys (10) and arranged to form two series of side-by-side pulleys, in which one pulley (32) in two is associated with a tensioner (40); and
- a plurality of diamond-set wires (26) extending endlessly about two guide pulleys (10), a deviation pulley (32) associated with a tensioner (40) and a deviation pulley (30) not associated with a tensioner.

2. A machine as claimed in claim 1, characterised in that one set of guide pulleys (10) is keyed onto a shaft (8) connected to a motor (16) for its rotation, the other set of guide pulleys (10) being mounted idly on the other shaft (8′).

3. A machine as claimed in claim 1, characterised in that one (8′) of the two horizontal support shafts for the guide pulleys (10) can be shifted away from and towards the other horizontal shaft (8).

4. A machine as claimed in claim 3, characterised in that the shiftable shaft (8′) is supported by supports fixed to carriages (18) which are movable relative to the structure of the multiple tool.

5. A machine as claimed in claim 1, characterised in that the guide pulleys (10) are fixed to rotate rigidly with each other and are kept a predetermined distance apart by interchangeble spacers (22) interposed between them.

6. A machine as claimed in claim 5, characterised in that each guide pulley (10) comprises recesses (20) in both its surface for housing the spacers (22).

7. A machine as claimed in claim 6, characterised in that said recesses (20) and said spacers (22) comprises a hole for the insertion of a rod (24) for fixing the various guide pulleys (10) together.

8. A machine as claimed in claim 6, characterised in that the recesses (20) are positioned radially at the same angular distance apart.

9. A machine as claimed in claim 1, characterised by

comprising two shafts (28) situated in a position overlying the shafts (8,8') and supporting the deviation pulleys (30), which are mounted idly on them.

10. A machine as claimed in claim 1, characterised in that each tensioning pulley (32) comprises a hole centrally traversed by the shaft (28), of smaller diameter than said hole, and is supported by a fork-shaped support (36) fixed to the structure of the multiple cutting tool.

11. A machine as claimed in claim 10, characterised in that an articuled joint (38) is interposed between the fork-shaped support (36) and the relative tensioner (40).

12. A machine as claimed in claim 1, characterised in that each tensioner (40) is of the type able to exert a tension on the relative pulley (32) but without displacing it from the plane in which it lies.

13. A machine as claimed in claim 1, characterised in that the deviation pulley (30) and tensioning pulley (32) relative to each diamond-set wire (26) are positioned in a plane slightly displaced from the vertical plane in which the corresponding guide pulleys (10) lie.

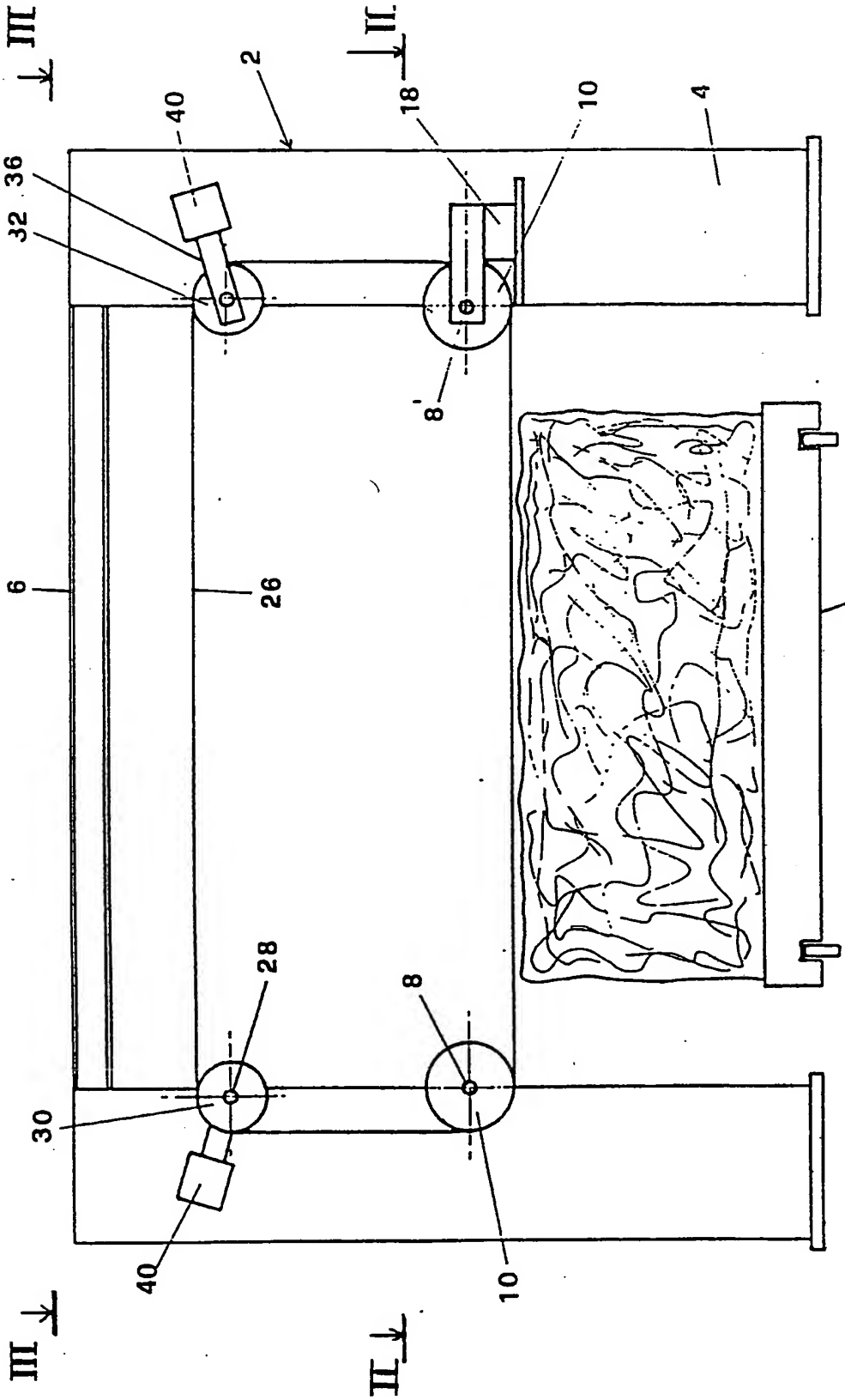

FIG.1

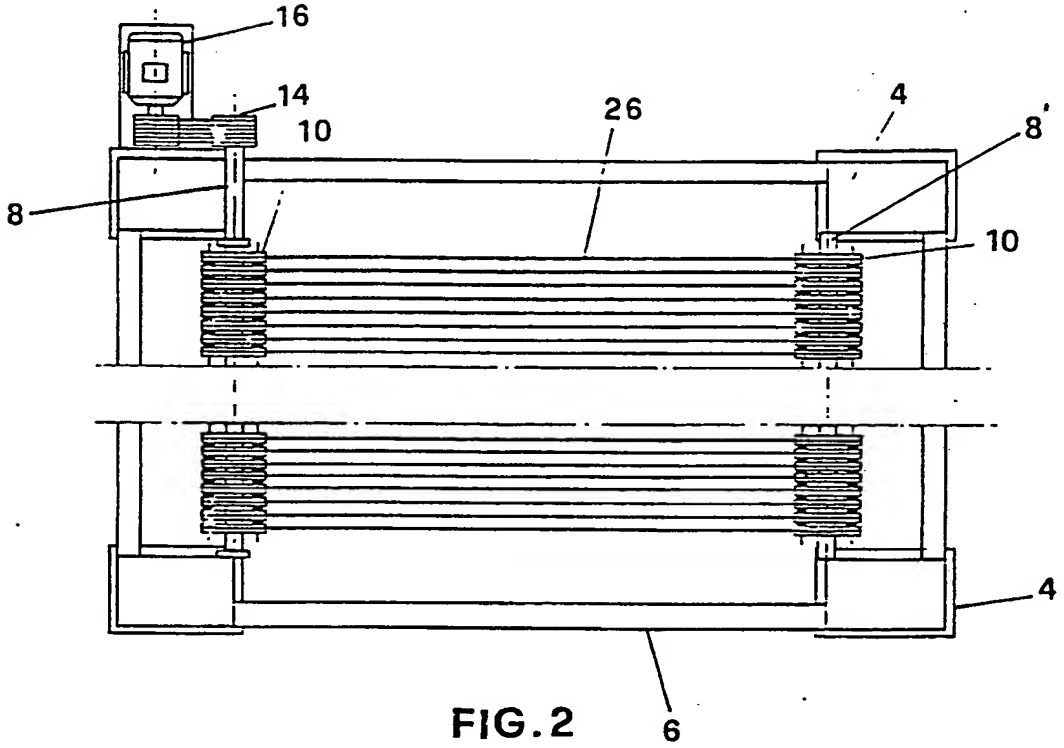

FIG. 2

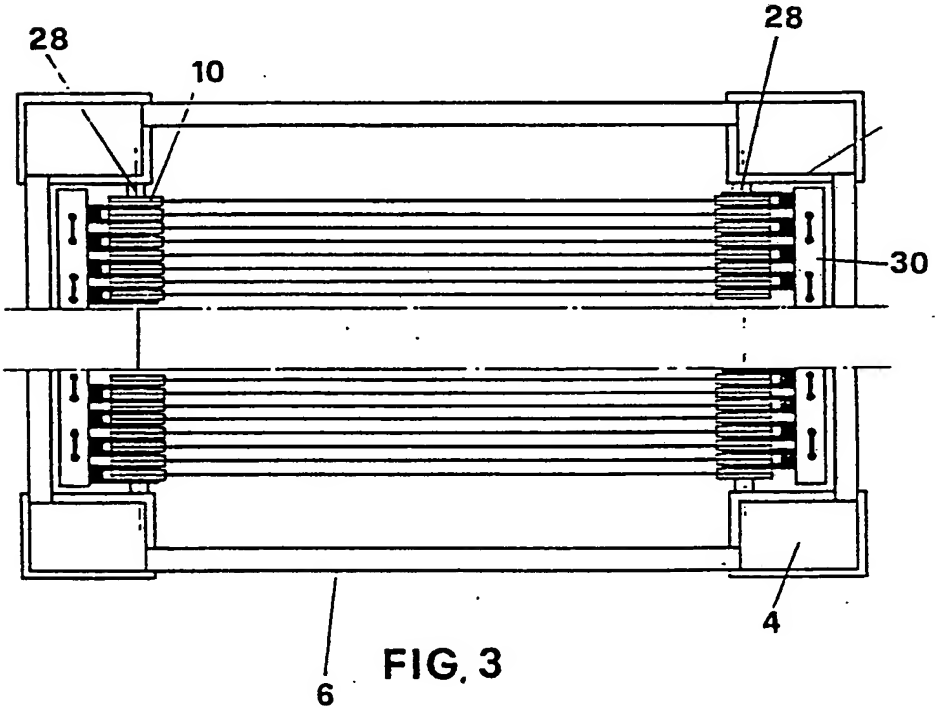

FIG. 3

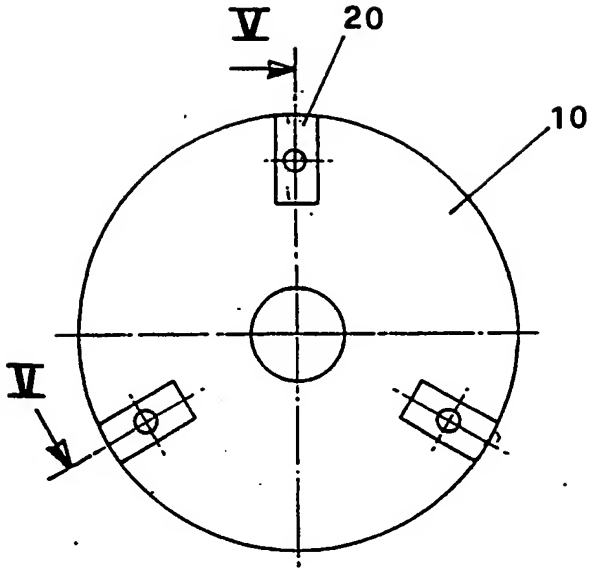

FIG.4

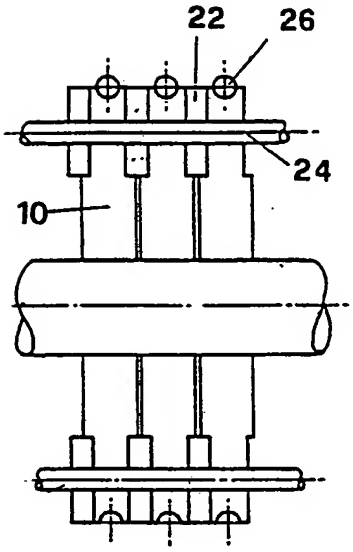

FIG.5

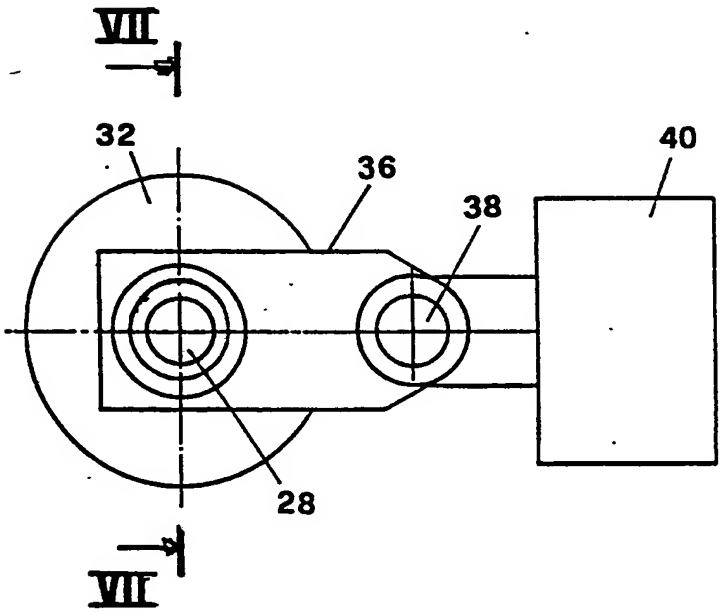

FIG.6

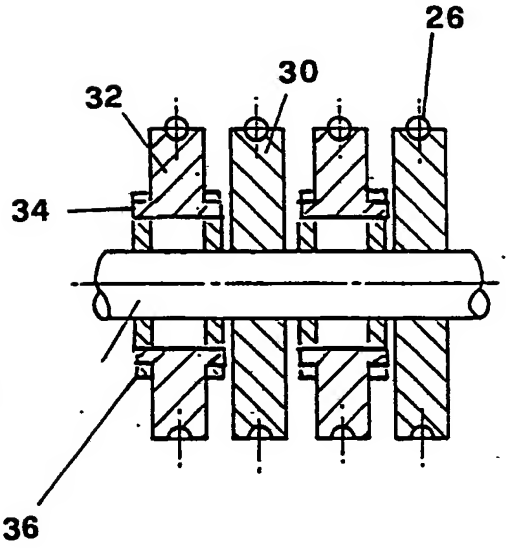

FIG.7